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Soybean and Alfalfa Hays for Wintering Pregnant Ewes

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SUMMARY

1. Soybean hay compares very favorably with alfalfa hay in feeding value on the basis of results secured in this experiment on wintering breeding ewes. A combination of soybean and alfalfa hays is also an efficient roughage.

2. Less grain was required to keep the ewes in the requisite condition when soybean hay was used in place of alfalfa. The ewes required less grain when a combination of soybean and alfalfa hays was fed than when either hay was fed singly. This saving of grain is an important item in the economical wintering of the pregnant ewe. Good soybean hay carries a concentrate, the seed, which is responsible in large measure for the lessening of the grain requirement.

3. A greater consumption of salt was stimulated by the use of soybean hay. When alfalfa was the only hay fed the salt consumed per ewe in 100 days was 2.2 pounds. The replacement of half of the alfalfa (compare Groups I and III) with soybean hay ran the salt requirement up to 4.3 pounds, practically doubling it. When the soybean hay entirely replaced the alfalfa the salt consumption was increased some 64 percent, or 1.4 pounds to the average ewe in the hundred days.

4. From the standpoint of new-born lamb production, the rations were practically equal in efficiency. In all of the groups the factors of weight, condition and period of gestation of the ewes; the number of lambs per ewe; the weight, vigor, degree of fatness and wool covering of the new-born lambs; and the stature of the day-old lambs were comparable. The slight differences existing, and they are small in all cases, are probably within the limits of expected experimental error.

5. Soybean hay was equal in feeding value to more than an equal weight of a combination of alfalfa hay and shelled corn. Using the edible feed consumed daily per head as the basis of comparison, 100 pounds of soybean hay (compare Groups I and II) saved 102 pounds of alfalfa hay and 54 pounds of corn, a total of 156 pounds.

On the same basis of computation, 100 pounds of soybean hay fed to Group III saved, as compared to the check Group I, 108 pounds of alfalfa and 26 pounds of corn, a total of 134 pounds.

When soybean hay replaced alfalfa entirely, 100 pounds of this hay (compare Groups I and IV) saved 107 pounds of alfalfa and 11 pounds of corn, a total of 118 pounds.

6. The replacement of part or all of the alfalfa hay by soybean hay resulted in an increase in yield of scoured wool.

7. If both alfalfa and soybean hays are available, "combination" feeding along with corn silage, corn and salt is desirable; however, either hay fed as the lone hay under conditions similar to those in this experiment should give good results.

Soybean and Alfalfa Hays for Wintering Pregnant Ewes

By W. E. Hammond, John M. Evvard and C. C. Culbertson

Since the soybean acreage has increased in Iowa and the Corn Belt, the determination of the economic feeding value of this plant deserves attention.

Alfalfa and clover have long been considered good legume hays for sheep. Because of the increase in soybean production, which involves a greater volume of soybean hay, the question naturally arises as to how this legume hay compares in feeding value with clover and alfalfa. With this question in mind four lots of pregnant ewes were experimentally fed on soybean and alfalfa hays and certain combinations of these two hays. The results secured are reported herein.

PREVIOUS EXPERIMENTAL WORK IN SOYBEAN HAY FEEDING

There is little available literature on the value of soybean hay as compared to other cured leguminous roughages commonly grown in Iowa.

SOYBEAN HAY FOR SHEEP

Skinner and King¹ of the Indiana Agricultural Experiment Station fed two groups of western lambs, averaging 68.2 pounds per head, for a period of 80 days in order to compare clover and soybean hay when each was added to a basal ration consisting of shelled corn, cottonseed meal, corn silage and salt.

The authors report that the soybean hay was only fair in quality inasmuch as a portion of it was too ripe when harvested, and part of it showed considerable mold. The clover hay was of good quality.

In this experiment the lambs refused more than 20 percent (coarse stems) of the soybean hay offered. When the relative values of the two hays are figured on the basis of the hay offered, the soybean hay had a value of only about 79 percent as much as that of the clover hay. If figures are based on the hay actually consumed, the soybean hay had a value somewhat greater than the clover.

Recent results in feeding soybean hay to lambs secured by Kammlade and Mackey² of the Illinois Agricultural Experiment Station, in two experiments, of 96 and 84 days, respectively, indicate that this hay was not equal to alfalfa when full-fed with shelled corn (and presumably salt). In the first

¹Skinner, J. H. and King, F. G. Fattening Western Lambs, Ind. Agr. Exp. Sta. Bul. 282, 1924.

²Kammlade, W. G. and Mackey, A. K. The Soybean Crop for Fattening Western Lambs, Ill. Agr. Exp. Sta. Bul. 260, 1925.

experiment the alfalfa-hay-fed lambs gained 0.34 pound and the soybean-hay-fed ones 0.33 pound daily per head; in the second experiment the gains were 0.32 and 0.31 pound, respectively. The average daily feed allowance in pounds in both experiments was 1.12 corn, plus 1.39 alfalfa versus 1.11 corn, plus 1.63 soybean hay. The feed required for the hundred pounds of gain made was 344 pounds of corn, plus 425 pounds of alfalfa (of which 389 was consumed, the refuse being 8.5 percent) versus 349 pounds of corn, plus 510 pounds of soybean hay (of which 395 was consumed, the refuse being 22.5 percent, or almost three times the alfalfa discard). In these experiments a ton of alfalfa hay equalled in feeding value, 2,401 pounds of soybean hay plus 24 pounds of shelled corn. At this rate it took approximately one-fifth more soybean hay than alfalfa (gross) to supply roughage for each hundred-weight of gain produced. The soybean hay actually consumed was almost as good, pound for pound, as the edible alfalfa.

Evvard, Culbertson, Hammond and Henness³ of this station compared soybean hay with clover for fattening lambs. The soybean hay fed was a mixture of varieties. A part of this hay was of poor quality inasmuch as it lay on the field for approximately three weeks and heavy rains delayed the curing process. The remainder of the hay was of good quality, coming from the experimental plots of the station.

The clover and soybean hays were fed in conjunction with shelled corn, cottonseed meal, corn silage and block salt.

Soybean hay reduced the feed required for each 100 pounds of gain, as compared to the clover-hay-fed check lot. More than 22 percent of the whole soybean hay was refused. When the hay was ground the lambs were forced to consume nearly all of it, but the lambs were less valuable on the market.

The lambs fed whole and ground soybean hay dressed slightly higher than those fed clover hay.

With clover valued at \$16 per ton, whole soybean hay as fed to two lots of lambs, was worth nearly \$23 per ton, ground soybean hay nearly \$15 per ton and ground soybean hay mixed with the grain less than \$4 per ton.

SOYBEAN HAY FOR CATTLE

Bohstedt⁴ of the Ohio Agricultural Experiment Station conducted an experiment in which soybean and clover hay were compared when fed with shelled corn and corn silage to fattening yearling steers in dry lot. The soybean hay was of the Ito San variety, being fine stemmed and of good color. The

³Evvard, John M.; Culbertson, C. C.; Hammond, W. E., and Henness, K. K. Soybean Hay for Fattening Lambs, Iowa Agr. Exp. Sta. Bul. 234, 1926.

⁴Bohstedt, G. Fattening Calves, Yearlings, and Two-Year-Olds. Mo. Bul. Ohio Agr. Exp. Sta. IX, Nos. 9 and 10, 1924.

clover was a good grade of the first cutting of medium red. The average daily gains were the same for both lots, or 2.22 pounds, but the cattle fed soybean hay showed a higher feed consumption. Bohstedt reports that the steers refused 3.71 percent of the soybean hay and 2.53 percent of the clover hay.

The clover-hay-fed cattle sold for 25 cents more per hundred-weight and yielded a greater margin per steer over feed costs after crediting the feed saved by the hogs following. The results of Bohstedt's work show that in order to return the same margin per steer over feed cost, crediting feed saved by hogs, the feeder could have afforded to pay only 74 percent as much for the soybean as for the clover hay. On this basis, with clover hay worth \$15 per ton, soybean hay had a feeding value of \$11.10 per ton.

Evvard, Culbertson, Hammond and Wallace⁵ of this station compared year-old soybean hay of the Wilson variety with the current crop of red clover hay. The cattle received shelled corn, hand-full-fed, 1½ pounds of linseed oilmeal, and block salt self-fed in addition to the hay.

The soybean hay proved to be worth only about one-third as much per ton as clover hay. With the clover hay charged at \$20 per ton, the feeder could have paid only \$6.59 per ton for the soybean hay and still make the same margin per steer over feed costs, crediting "pickup." The soybean hay was somewhat coarse, 16.57 percent of it being refused by the cattle; only 5.48 percent of the clover-timothy hay offered was refused. The clover hay fed was below a No. 2 grade; it contained about 15 percent of material other than clover—largely cornstalks, a considerable portion of which was refused by the cattle. The soybean hay as fed contained 9.96 percent beans, by weight.

It appears that, on the average, judging from these two experiments, soybean hay may be considered as being worth less than clover hay. The relative value depends upon the quality of the hays compared. Soybean hays differ markedly. Much depends on the variety used, stage of maturity, yield of seed and other important controlling factors.

Skinner and King⁶ of the Indiana Experiment Station compared soybean hay (Hawtaw variety) with clover hay for fattening cattle. They found that the substitution of soybean hay for clover hay in a ration of shelled corn, cottonseed meal and corn silage had no effect on concentrate consumption but increased the rate of gain and decreased the cost of gain. The

⁵Evvard, John M.; Culbertson, C. C.; Hammond, W. E.; and Wallace, Q. W. Unpublished Data, Iowa Agr. Exp. Sta., 1924.

⁶Skinner, J. H. and King, F. G. Cattle Feeding, Winter Steer Feeding, Ind. Agr. Exp. Sta. Bul. 314, 1927.

selling value of the cattle was the same in both lots but, because of more economical gains, cattle receiving soybean hay returned larger profits.

In an indirect comparison made between soybean hay and clover hay with corn silage when these roughages were fed in conjunction with shelled corn and cottonseed meal, the soybean-hay-fed cattle gained as well as those fed clover hay and silage. The feeding of 13.41 pounds of soybean hay replaced 32.19 pounds of corn silage and 3.01 pounds of clover hay, but increased the corn consumption 2.54 pounds daily per steer. The cost of gains was increased 68 cents per 100 pounds gain. The relative selling value was not affected by the ration. The profits per steer were lower in the lot receiving only soybean hay as the roughage than when corn silage and clover hay were fed.

EXPERIMENTAL PROCEDURE

DURATION OF EXPERIMENT

The experimental period began Oct. 2 and continued thru breeding, gestation and suckling until the lamb or lambs of each ewe were 60 days old, or until the ewe proved not to be in lamb at her regular lambing date.

OBJECTS OF THE EXPERIMENT

The objects of the experiment herein reported were to find the relative value of alfalfa hay, soybean hay and two different combinations of these hays; to note particularly the relative effects of soybean hay upon feed consumption, salt consumption, gains of the ewes, fleece growth on ewes, health of ewes, character of offspring; to make a special study of the effect of the rations upon the character of the offspring, judging from the standpoint of vigor, condition, character of bone, character of coat, body development and general health, and to note the effect of the rations upon the suckling ability of the ewes.

ANIMALS USED IN THE EXPERIMENT

The ewes used in this experiment were grade Hampshire ewes, all of them carrying from one-half to three-quarters Hampshire blood, top crossed on foundation ewes showing some Merino, Shropshire, Leicester, Southdown and Ryeland. The ewes ranged from 2 to 6 years of age at lambing time.

PREVIOUS MANAGEMENT

During the summer previous to the experiment these ewes were run on a bluegrass timber pasture. The ewes did not receive any grain on pasture; their lambs had been weaned in

the middle of the summer; hence, they had three to three and one-half months of rest before the breeding season opened.

During the breeding season, which began Oct. 3 and ended Nov. 11, the ewes were run on bluegrass without additional grain. Some silage was fed about a week before starting the experiment proper.

The ewes at the beginning of the experiment ranged from common to good in condition, with the majority medium to good. The health and thriftiness of the ewes were good; a few were thin but in good health and suitable for experimentation.

The ram used was a purebred Hampshire lamb, weighing 120 pounds when breeding started.

ALLOTMENT

Forty ewes were divided into four lots of ten ewes each. In making the allotment, consideration was taken of weight, condition, days pregnant, breeding, age, prospective outcome and previous fleece weights.

Three individual weights were taken at the beginning of the experiment, one individual weight being taken each 30 days. At the end of the 90-day period, just before the ewes began to lamb, three individual weights were taken. Three daily consecutive weights were taken just before each ewe lambed and one weight after lambing. At the end of the 60-day suckling period a single weight was taken of the ewe and lamb.

The ewes were housed in a feeding shed open to the east. This shed was protected on the north by a steer feeding barn which extended eastward. Each of the lots in which the ewes were kept measured approximately 18 by 18 feet. The ewes on "sunshiny" days were turned for exercise into an open paddock about 50 yards long and 20 feet wide, an area of about $\frac{1}{3}$ acre.

Fresh hydrant water was kept before the ewes at all times.

RATIONS FED DURING GESTATION PERIOD

Group I—Shelled corn, mixed in color, mostly yellow, hand-fed, limited to 1 pound per ewe, a. m. feed; corn silage (approximately 2.3 pounds per head daily, a. m. feed); alfalfa hay full-fed in afternoon only, and block salt self-fed.

Group II—Same as Group I except shelled corn, limited so as to regulate gains to approximately those of Group I; alfalfa hay, approximately three-fourths as much as offered Group I; and soybean hay full-fed.

Group III—Same as Group I except shelled corn, limited so as to regulate gains to approximately those of Group I; alfalfa hay, approximately one-half as much as offered Group I, and soybean hay full-fed.

Group IV—Same as Group I except shelled corn, limited so

as to regulate gains to approximately those of Group I, and soybean hay full-fed.

TIME AND ORDER OF FEEDING

The ewes were fed at approximately 7:30 a. m. and 4 p. m. The order of feeding was as follows:

Morning feed—shelled corn, corn silage.

Afternoon feed—alfalfa or soybean hay or the combination of these hays.

FEEDS DESCRIBED

Shelled Corn

The shelled corn fed ranged from 17 to 18 percent in moisture and was a No. 4 grade. It was secured locally. Moisture determinations were made monthly on composite samples. The corn is charged against the ewes on a computed 14-percent moisture basis.

Alfalfa Hay

Alfalfa hay was approximately a No. 2 grade and was purchased direct from the grower in Nebraska.

Soybean Hay

Soybean hay contained a mixture of varieties. The average yield was approximately $2\frac{1}{2}$ tons per acre. A ton of the roughage carried 6.32 bushels (379.2 pounds) of beans, or 18.46 percent.

The varieties in the soybean hay fed were as follows:

Black Eyebrow*	Mongol
Chestnut*	Ogemany*
Early Brown*	Peking
Ebony	Roosevelt
Elton*	Sable
Hollybrook	Stone's Ensilage
Ito San*	Virginia
Manchu*	Wilson
Medium Green	Wilson Five
Habaro*	Rayne

*Indicates early maturing varieties.

Corn Silage

The corn silage came from the current corn crop. The silage fed from Dec. 27, to Feb. 17, was poorer in quality than that fed later. It had been made from late planted corn which had been frosted before ensiling and thus lost many of the leaves. The average yield of corn silage per acre was only 4.49 tons. The corn yielded only 27.23 bushels, figured on 14-percent moisture basis, per acre. This silage therefore carried 6.06 bushels of corn grain per ton.

Block Salt

The block salt had approximately 99 percent sodium chloride (chemically pure salt).

Water

Regular college hydrant water was used.

CHEMICAL ANALYSIS OF FEEDS

The chemical composition of the feeds used in this experiment as reported by the Chemistry Section of the Iowa Agricultural Experiment Station is presented in table I.

TABLE I.

Feeds	Water	Dry matter	Crude protein	Nitrogen free-extract	Crude fiber	Fat	Ash
Shelled corn*	14.00	86.00	8.89	71.00	2.25	2.24	1.32
Alfalfa hay	7.01	92.99	13.27	34.11	35.58	2.26	7.77
Corn silage	6.36	93.64	8.07	59.38	19.05	3.01	4.12
Soybean hay	6.46	93.54	29.13	30.39	17.17	11.64	5.19
Soybean hay leaves	7.77	92.23	12.00	42.39	28.40	2.36	7.08
Soybean hay stalks	6.53	93.47	7.62	36.26	45.57	0.73	3.29
Soybeans (Grain)	6.11	93.98	39.80	25.62	6.00	17.20	5.27
Soybean hay refuse	6.53	93.47	7.62	36.26	45.57	0.73	3.29

*Adjusted to 14 percent moisture basis.

SUCKLING PERIOD MANAGEMENT

All of the ewes and lambs were run together in dry lot. The following ration was hand-full-fed to the ewes: Grain mixture (shelled corn 70 parts, whole oats 20 parts and linseed oilmeal 10 parts) plus corn silage full-fed; alfalfa hay was kept before the ewes and lambs at all times; block salt was self-fed.

The lambs were self-fed shelled corn, whole oats and linseed oilmeal in separate compartments of a trough in a creep.

Corn silage feeding was discontinued from April 2 to April 30, at which time silage was available for three days again. After May 13 clover hay was fed in place of alfalfa hay.

DISCUSSION OF EXPERIMENTAL RESULTS

GAINS MADE BY EWES

Soybean hay, in this experiment, was a very satisfactory partial or entire substitute for alfalfa in feeding pregnant ewes. The four groups of ewes made a satisfactory average daily gain of a little over 0.41 pound. The substitution of soybean hay for one-fourth of the alfalfa in Group II, one-half of the alfalfa in Group III and the entire replacement of alfalfa hay by soybean hay in Group IV, did not cause a significant variation in the average daily gain. The average daily gain of the best groups (I and II), was 0.44 pound while that of the poorest gaining group (Group IV) was 0.41 pound, a difference of only 0.03 pound.

AVERAGE DAILY FEED CONSUMED PER EWE

The ewes fed alfalfa hay as the sole roughage consumed more shelled corn per day than did the ewes of any group receiving

soybean hay (see table II). This decrease in consumption of corn on the part of the "soybean hay" groups was undoubtedly due to the large amount of soybeans in the hay. The reduction in shelled corn, however, was not in direct proportion to the amount of soybean hay fed. Group II which had only one quarter of the alfalfa hay replaced by soybean hay consumed 0.34 pound less corn per ewe daily than the alfalfa hay group, I. The reduction of corn consumed in Group III was only 0.31 pound less than in Group I. In Group IV, with soybean hay entirely replacing alfalfa, the shelled corn consumed was only 0.26 pound less than that of Group I.

TABLE II. FEEDING AND GAINS RECORD OF THE EWES

Group No.	Average time from Nov. 29 to lambing or removal time (round Nos.) Days	Average daily gain per ewe Pounds	Total gains per ewe computed for 166 days (round Nos.) Pounds	Ration	Average daily feed consumed per ewe Pounds	Total feed required per ewe (basis of 166 days) Pounds
I	106	0.44	73	Shelled corn	.95	158
				Corn silage	2.32	385
				Alfalfa hay	2.61	433
					(2.73)*	(453)*
				Block salt	.022 5.90	3.7 980
II	103	0.44	73	Shelled corn	.61	101
				Corn silage	2.32	385
				Alfalfa hay	1.97	327
					(2.05)	(340)
				Soybean hay	.63	105
III	103	0.43	72		(.74)	(123)
				Block salt	.026 5.56	4.3 953
				Shelled corn	.64	106
				Corn silage	2.31	383
				Alfalfa hay	1.30	216
IV	103	0.41	68		(1.26)	(226)
				Soybean hay	1.21	201
					(1.40)	(232)
				Block salt	.043 5.50	7.1 954
				Shelled corn	.69	115
				Corn silage	2.34	388
				Soybean hay	2.43	403
					(2.82)	(468)
				Block salt	.036 5.50	6.0 924

*Figures in parenthesis are for the hay offered. All other figures are consumption.

As the proportion of soybean hay was increased in the ration, the total edible hay (hay offered minus hay refused) consumed daily per ewe decreased. Groups I and II, however, ate approximately the same amounts of hay, namely, 2.61 and 2.60 pounds daily. With the heavier allowance of soybean hay in Groups III and IV, the edible hay eaten daily per ewe was 2.51 and 2.43 pounds.

The refused portions were 4.25 percent of alfalfa hay and 13.77 percent of the soybean hay (see table III).

The salt consumption of the ewes was stimulated by the introduction of soybean hay as a partial or sole substitute for alfalfa hay. With alfalfa as the only hay fed the salt con-

TABLE III. SOYBEAN AND ALFALFA HAYS OFFERED AND REFUSED
Per Ewe Daily Entire Period

Group No.	Alfalfa hay			Soybean hay		
	Offered	Consumed	Percent refused	Offered	Consumed	Percent refused
I	2.729	2.613	4.25	—	—	—
II	2.051	1.969	3.99	.737	.634	13.98
III	1.355	1.300	4.06	1.403	1.210	13.76
IV	—	—	—	2.817	2.429	13.77

sumed per ewe in 100 days was 2.2 pounds. With one-half of the alfalfa replaced by soybean hay (compare Groups I and III) the salt consumption was practically doubled, or an increase from 2.2 to 4.3 pounds per 100 days. When soybean hay entirely replaced alfalfa, the salt consumption was increased only 1.4 pounds over that of Group I. The ash of soybean hay carries approximately three times as much sodium and six times as much chlorine as that of alfalfa. Inasmuch as both hays contain approximately 9 percent ash, it appears that the soybean-hay-fed ewes would require less additional salt than ewes fed alfalfa hay.

The average length of the gestation periods was nearly uniform, 144.98 days for Group I, 144.2 days for Group II, 144.52 for Group III, and 143.54 days for Group IV (see table IV).

TABLE IV. BREEDING AND GESTATION RECORD
10 Ewes Per Lot

Group No.	No. of ewes lambing	No. of lambs	Breeding services required, average per ewe	Days in breeding season to settle average ewe	Average gestation period Days
I	9	14	1.5	16.22	144.98
II	10	16	1.5	16.00	144.20
III	10	16	1.4	15.70	144.52
IV	8	13	1.5	16.13	143.54

From the lambing standpoint and new-born lambs produced, all rations were practically equal in efficiency (see table V). The condition of the ewes as lambing time was graded as "good," except for Group III which rated "medium to good."

The number of lambs per ewe was practically the same in all lots, ranging from 1.56 in Group I to 1.63 in Group IV.

Soybean hay fed alone as in Group IV and a combination of soybean hay and alfalfa hay as fed Group III produced slightly heavier lambs. The extreme average birth weights of 10.11 pounds for the lambs of Group III and 9.25 pounds for those of Group II show such a small variation that the single roughage or combinations may be considered of equal value in this respect. The lambs from all the lots ranked the same in average vigor, condition and wool covering. The stature of the day-old lambs, as ascertained by measurements, was on the

TABLE V. LAMBING RECORD

Group No.	Condition of average ewe at lambing*	No. of lambs	Lambs per litter (Av.)	Average weight		Average vital characteristics of lambs			Loss of ewe weight in lambing, pounds
				Per litter pounds	Per lamb pounds	Vigor** or strength	Condition or fatness	Wool covering	
I	64.82 (good)	14	1.56	15.18	(a) 9.88 (b) 9.76	86 Strong +	67 good	75 good to choice	29.6
II	65.84 (good)	16	1.60	14.31	(a) 9.25 (b) 8.94	88 Strong +	65 good	75 good to choice	27.7
III	62.50 (good)	16	1.60	15.74	(a) 10.11 (b) 9.84	88 Strong +	68 good	75 good to choice	30.1
IV	66.67 (good)	13	1.63	15.90	(a) 10.05 (b) 9.78	85 Strong +	64 good	77 good to choice +	30.8

* Prime condition equals 100 percent. The ewe that carries 60-65 units of condition or fatness is considered as showing sufficient degree of fatness for parturition and subsequent suckling period.

** The grades used for vigor are "very strong", "strong", "medium", "weak", "very weak" and "dead".

(a) equals average of average per litter.

(b) equals average of all lambs.

TABLE VI. GROWTH AND DEVELOPMENT OF LIVING LAMBS

Group No.	No. of lambs	Av. initial weight pounds	Average initial measurements per lamb										
			Circumference			Shoulder point to ischium*	Shoulder top to ischium**	Width of hips	Height at withers (shoulder)	Circumference		Length of foreleg	
			Heart	Paunch	Flank					Front shin	Hind shin		
			All measurements in inches										
I	10	9.99	38.80	39.40	38.50	33.40	31.55	7.70	36.60	6.11	6.42	25.60	
II	14	9.17	37.96	38.43	37.64	31.96	30.46	7.31	35.43	5.79	6.25	25.39	
III	12	10.32	39.08	40.42	39.67	30.17	28.88	7.77	36.92	5.94	6.44	26.04	
IV	9	10.43	39.00	39.89	38.56	33.72	32.33	7.88	37.67	5.98	6.39	26.56	
I II III IV	10 14 12 9	Av. final wt.	Average final measurements per lamb										
			70.70	79.50	69.40	60.40	57.50	17.80	50.30	8.55	9.06	33.25	
			51.50	68.50	77.57	69.71	60.50	58.14	17.14	51.14	8.31	8.89	32.64
			51.42	69.67	80.25	72.25	61.42	58.75	17.42	51.00	8.33	9.23	32.75
			51.33	72.56	80.89	73.67	59.56	57.56	16.92	52.22	8.22	8.92	33.61
I II III IV	10 14 12 9		Average absolute increase per lamb										
			31.90	40.10	30.90	27.00	25.95	10.10	13.70	2.44	2.64	7.65	
			30.54	39.14	32.07	28.54	27.68	9.84	15.71	2.53	2.64	7.25	
			30.58	39.83	32.58	31.25	29.88	9.65	14.08	2.39	2.79	6.71	
			33.56	41.00	35.11	25.83	25.22	9.04	14.56	2.24	2.53	7.06	

*This measurement is taken from tuberosity of humerus to the posterior end of ischium, or from point of shoulder to "pin bone."

**This measurement taken from point between shoulder blades diagonally across body to "pin bone."

average comparable in all groups. In most cases only small differences were found, and these in all probability come within the limits of experimental error (see table VI).

Significant differences apparently occur in the feed requirements of the ewes. The relatively high value of the soybean hay in terms of replacing alfalfa hay and corn is particularly noteworthy. The soybean hay was equal in feeding value to more than an equal weight of combined edible alfalfa hay and shelled corn. The feeding of 0.63 pound of soybean hay per ewe daily in Group II saved 0.64 pound of alfalfa hay and 0.34 pound of corn as compared to Group I when figured on the edible basis. Expressing it in another way, for each 100 pounds of soybean hay consumed, 102 pounds of alfalfa hay and 54 pounds of corn or a total of 156 pounds of feed was saved. Further study shows soybean hay to be more effective when fed with alfalfa hay than as the sole roughage. When soybean hay was fed alone, it replaced only 118 pounds of hay and grain; as a mixture of these two hays saved 156 pounds of grain and hay (see table VII). (Compare Groups II and IV.)

TABLE VII. REPLACEMENT VALUE OF 100 POUNDS SOYBEAN HAY AS FED
(All Groups Compared to Lot I)

Group No.	Edible basis, pounds			Entire basis, pounds		
	Alfalfa	Corn, shelled	Total alfalfa hay plus shelled corn	Alfalfa	Corn, shelled	Total plus hay
II	102	54	156	92	46	138
III	108	26	134	98	22	120
IV	107	11	118	97	9	106

When both alfalfa and soybean hay are available for the ewes, it appears that the combination of the two with silage, corn and salt makes a very good ration. Nevertheless, either of these two hays fed singly should give good results.

Neither hay fed alone nor in combination with the other produced any appreciable variation in average yield of wool per ewe. The average wool yield varied from 9.19 pounds in Group III to 9.67 pounds in Group II. The scouring or shrinkage percentage varied widely between the different lots. The largest difference was between the lots fed alfalfa and soybean hay as the only roughage. Between Groups I and II the difference in scouring percentage was only 0.6 percent, while the biggest difference occurred between Groups I and IV where there was a difference of 4.35 percent in favor of Group IV. Figuring further, we find that in Group I (alfalfa hay) for each 100 pounds of wool sheared, 55.79 pounds of scoured wool was obtained; Group II (alfalfa three-fourths as much as Group I, soybean hay self-fed) produced 57.39 pounds of scoured wool,

Group III (fed one-half as much alfalfa as Group I, soybean hay self-fed (produced 59.88 pounds of scoured wool and Group IV (soybean hay) produced 61.04 pounds of scoured wool. This was a steady increase in scoured wool produced in favor of soybean hay feeding (see table VIII).

TABLE VIII. WOOL PRODUCTION RECORD

Group No.	No. fleeces weighed	Fleece weights at shearing time			Price per pound (appraised value)	Grade of Fleece						Scouring or shrinkage percentage (based on shearing weights)*	Scoured wool, yield per 100 pounds fleeces pounds
		Minimum	Maximum	Average		Combing			Clothing				
						¼	⅜	½	¼	⅜	½		
I	10	7.90	10.60	9.50	\$0.66	1	6	2	0	1	0	44.21	55.79
II	10	7.20	11.50	9.67	\$0.67	2	5	0	0	3	0	43.61	57.39
III	10	7.60	11.50	9.19	\$0.66	2	6	0	0	2	0	40.12	59.88
IV	8	8.00	11.80	9.25	\$0.66	2	4	0	0	2	0	39.86	61.04

*Based on home weights.

The selling price per pound (an appraised value) was the same for all lots, or 66 cents, with the exception of Lot II which sold for 67 cents.

ADDENDUM

VARIATION IN THE BIRTH WEIGHT OF LAMBS, LENGTH OF GESTATION PERIOD AND FLEECE WEIGHTS*

The mean birth weights of the lambs together with the probable errors and the average intra-group standard deviation are shown below.

BIRTH WEIGHT OF THE LAMBS

Group No.	Hay fed	No. of ewes lambing	No. of lambs (total)	No. of singles	No. of twins	No. of triplets	Mean birth weight per lamb, pounds
I	Alfalfa (full-fed)	9	14	4	5	0	9.8 ± .33
II	Alfalfa ¾ soybean (full-fed)	10	16	4	6	0	8.9 ± .33
III	Alfalfa ½ soybean (full-fed)	10	16	4	6	0	9.8 ± .33
IV	Soybean (full-fed)	8	13	3	5	0	9.8 ± .33

Av. intra-group standard deviation 1.96.

The main difference found was the low birth weight of the lambs in Group II. The difference, however, between Group II and the check Group I is only a little more than twice as large as the probable error and therefore may have been accidental. The average gestation periods together with their probable

*This is appended for the use of students who are interested in or are studying the technical interpretation of results.

errors and the average intra-group standard deviation of the ewes were as follows:

GESTATION PERIOD

Group No.	Hay fed	No. of ewes lambing	Mean days
I	Alfalfa (full-fed)	9	144.98 \pm .48
II	Alfalfa $\frac{3}{4}$ soybean (full-fed)	10	144.20 \pm 1.46
III	Alfalfa $\frac{1}{2}$ soybean (full-fed)	10	144.52 \pm 1.36
IV	Soybean (full-fed)	8	143.54 \pm 2.36

Av. intra-group standard deviation 6.80.

The mean number of days between breeding and lambing dates were close between the groups but there were considerable differences in uniformity between ewes. The ewes in Group I were very uniform in number of days while those in Group IV varied greatly.

None of the differences between the means were as large as the corresponding probable errors; hence, there is no strong indication that the differences in hays fed had any significant influence on the length of the gestation period.

The weights of the fleeces of the ewes together with the probable errors and the average intra-group standard deviation are shown below.

FLEECE WEIGHTS

Group No.	Hay fed	No. of ewes sheared	Mean fleece weight in pounds
I	Alfalfa (full-fed)	10	9.50 \pm .17
II	Alfalfa $\frac{3}{4}$ soybean (full-fed)	10	9.67 \pm .29
III	Alfalfa $\frac{1}{2}$ soybean (full-fed)	10	9.19 \pm .23
IV	Soybean (full-fed)	8	9.25 \pm .31

Av. intra-group standard deviation 1.17.

The uniformity of the fleece weights within each group differed but little. They were the most uniform in Group I. None of the differences between the group means was as much as twice its probable error. Moreover, such differences as were found do not progress steadily from the group which received no soybean hay to the group which received no alfalfa. There is therefore no evidence to indicate that the differences in hays or combinations of the hays fed affected the fleece weights.